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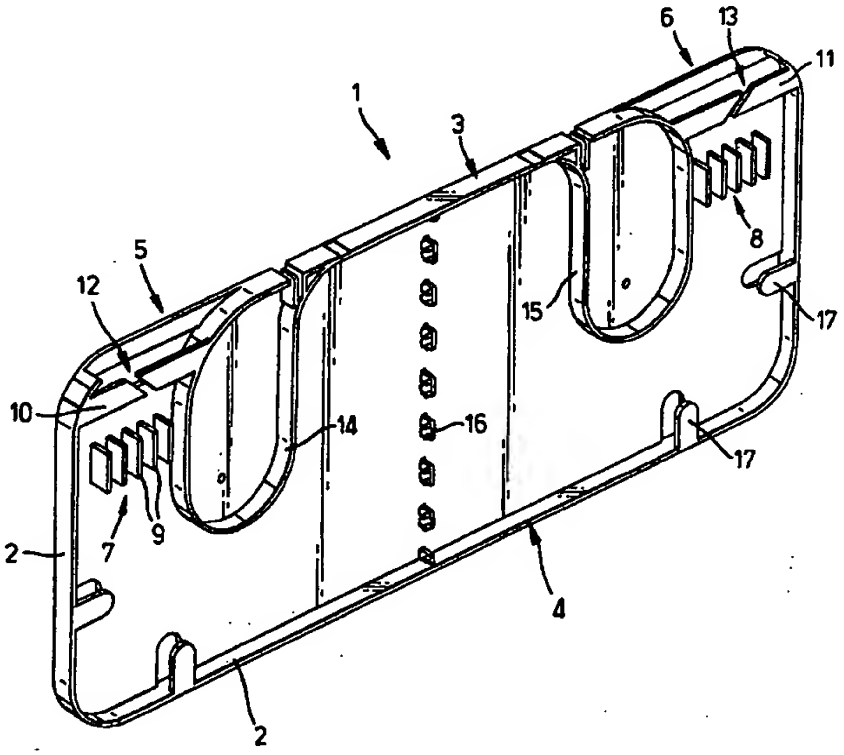
(54) Title: OPTICAL FIBRE CONNECTOR

(57) **Abstract**

A fibre optic patch panel tray (1) having a rear side (3) with two separate inlets (5, 6) for optical fibres, a front side (4), and at least one of the following: a) optical fibre bend radius control means (14, 15) adjacent to each inlet, and a plurality of connector retaining means (16) for retaining mateable fibre optic connectors extending across the tray between the rear and front sides; b) a first optical fibre retaining means (7, 8) adjacent the inlet (5, 6) having individual retaining elements (9) for removably retaining optical fibres; c) a second optical fibre retaining means (10, 11) adjacent the inlet (5, 6) extending across the inlet but having an opening (12, 13) at an angle to the path of optical fibres when retained by the first retaining means (7, 8) through which individual optical fibres can be passed when removed from the first optical fibre retaining means (7, 8).



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Description

Optical Fibre Connector

The present invention relates to optical fibre connections and to apparatus suitable for use in making such connections.

Connection between optical fibres may be permanent or semi-permanent. Such connections are usually termed splices. Various types of apparatus have been disclosed to assist in making and protecting splices between optical fibres.

There are circumstances in which direct splicing of optical fibres is not desirable. For example when telecommunications cable is connected to a customer's internal network by a distribution frame in which provision is made for the removal and reinsertion of fibres forming part of the internal network or for the rearrangement of connections.

In circumstances where it is necessary to move or interchange connections between optical fibres in order to modify a communications network it is undesirable to use permanent connections such as splices. Mateable (i.e. removable and reinsertable) connectors may be provided instead of splices. Instead of directly connecting together different parts of a network by mateable connectors it may be desirable to use intermediate lengths of optical fibre known as "pigtails". When connections between optical fibres have to be changed the use of pigtails enables the handling of the main lengths of optical fibre to be reduced. This reduces the risk of damage to the optical fibre.

The pigtails are generally held within a panel or tray to hold them in place and protect them.

In one form of pigtail a mateable connector may be provided at only one end of the pigtail, and the other end is left free for splicing to a main length of optical fibre. Alternatively the pigtail may carry a mateable connector at each end and both of the main lengths of optical fibre are provided with corresponding connections.

The process of connecting one length of optical fibre to another by means of an intermediate length of optical fibre is sometimes known as "patching".

Panels or trays suitable for use with pigtails for making removable and replaceable connection between optical fibres may be referred to as "patch panels".

Various type of fibre optic connector systems are known in the prior art.

EP 0159857 , for example, discloses a splice case for use with optical fibres comprising a plurality of hinged trays.

EP 0356942 discloses an apparatus for selectively connecting optical fibres comprising a slideable drawer.

US5071211 discloses a distribution frame for optical fibres which comprises a plurality of slideable trays. Each tray has means for storing a loop of optical fibre and for limiting its bend radius. There are a plurality of means for receiving mateable connectors of fibre pig tails -

EP 00408266A2 discloses a termination system for optical fibres carried in tubes. It discloses apparatus comprising a plurality of slidable trays. Ducts enter the tray from the rear, through which optical fibres enter the tray. Optical fibres entering through one duct are

connected by mechanical connectors. These connectors are removable to allow fibres within the tubes to be replaced.

The present invention provides a fibre optic patch panel tray having a rear side with two separate inlets for optical fibres, a front side, and at least one of the following:

(a) optical fibre bend radius control means adjacent to each inlet, and a plurality of connector retaining means for retaining mateable fibre optic connectors extending across the tray between the rear and front sides;

(b) a first optical fibre retaining means adjacent the inlet having individual retaining elements for removably retaining optical fibres;

(c) a second optical fibre retaining means adjacent the inlet extending across the inlet but having an opening at an angle to the path of optical fibres when retained by the first retaining means through which individual optical fibres can be passed when removed from the first optical fibre retaining means.

Advantages of the present invention are that it is of compact construction, and that it can be used with pigtails of fixed length. Another advantage is that it can be arranged to retain the fibres in place when connections have been made but which enable the fibre to be removed when new connections need to be made.

The patch panel trays of the present invention are intended to be used in groups which are mounted in a frame or support. The trays may be in the form of slideable trays stacked in a frame from which they can be slid. However such an arrangement requires a significant length of spare optical fibre to allow for the lateral movement of the tray. It is therefore preferred for the tray to be hinged with other trays

on a support, so that individual trays can be exposed by rotating the trays about the support. It will be understood that when the trays are hinged they hinged about the rear side. Hinging the trays at the rear edge, by which pigtails enter the tray, has the advantage that there is little or now disturbance (bending) of the pigtails when the tray is hinged to obtain access to it or other trays.

The support may be a drawer in which the trays are hinged. The drawer itself may be slideably mounted in a shelf in a rack..

The tray may be single sided. Alternatively the tray may be double sided with the required features on both faces of the tray.

Instead of supplying the bare tray, it may be desirable to supply panels with one or more pigtails already installed. The pigtails will comprise an optical fibre in an appropriate casing with a mateable connector at one end, which connector is installed in one of the connector retaining means. The other end of the optical fibre may be left free for splicing to another optical fibre, or may have another mateable connector.

In order to make the most effective use of the area of the tray the connector retaining means extend across substantially all the tray between the front and rear face. It will be necessary to provide bend radius control means which defines a path leading away from and then back towards the rear side. The provision of bend radius control means of the form defined above facilitates the use of pigtails of uniform length as it enable paths to be provided to the connector retaining means which are of equal length. The bend radius control means preferably defines a path extending from the adjacent optical fibre inlet to the rear most connector retaining means which is of substantially the same length as that from the adjacent optical fibre inlet to the front most connector means.

The provision of optical fibre retaining means adjacent to the inlet leaves sufficient free optical fibre on the tray to make and remake connections on the tray without risk of disturbing the lengths of optical fibre on the tray.

The provision of the first optical fibre retaining means allows the individual optical fibres to be retained on the tray but allows them to be detached from the tray if connection has to be made elsewhere, e.g. to another tray.

The second optical fibre retaining means extending over the optical fibres gives additional security to the optical fibres against becoming accidentally detached from the tray. However, the provision of an opening extending across the patch of the fibres when retained by the first means enables an optical fibre, when detached from the first fibre retaining means, to be manipulated so that a length can be aligned with and passed through the opening and so released from the second fibre retaining means without access to the end of the fibre. It may be desirable to provide a flexible second retaining means so that it can be bent manually to increase the size of the opening through which the optical fibre can be passed by movement of a length of the fibre away from the tray.

The number of connector retaining means on each tray is preferably restricted so that making patch connections on any given tray risks disturbing only a limited number of connections. It is common for optical fibres to be grouped together in tubes containing eight individual optical fibres and it is convenient to provide a maximum of eight connector retaining means on each tray. When additional connections are required a plurality of trays can be grouped together.

An advantage of the invention is that it allows manipulation and reconnection of optical fibres in a tray, or between trays with

substantially no disturbance of fibres further down the optical fibre bundle.

A second aspect of the present invention provides a method of making removable connections between two groups of optical fibres by means of an optical fibre pigtail retained on a tray, the method comprising

(i) removably locating a first set of optical fibre pigtails in an optical fibre retaining means mounted on the tray so as to leave a first set of free (preferably substantially equal) lengths of optical fibre each terminated by a mateable connector,

(ii) removably locating a second set of optical fibres in another fibre retaining means mounted on the tray so as to leave a second set of free (preferably substantially equal) lengths of said optical fibre each terminated by mateable connectors, the mateable connectors of the said first and second set of optical fibres being mateable together,

(iii) mating together the mateable connectors so as to connect the optical fibres,

(iv) locating the mateable connectors in connector retaining means arranged to align the connectors in a direction substantially perpendicular to the direction of the retained portions of optical fibre entering the tray.

The method steps (i) to (iv) need not necessarily be carried out in the order specified.

A specific embodiment of the invention will now be described, by way of example, with reference to the drawings in which:

Figure 1 is a perspective view of a single patch panel tray,

Figure 2 is a perspective view of part of a tray showing two pigtails with connections in place, and

Figure 3 is a perspective view of a plurality of trays according to the invention, hinged on a support.

The tray 1 has a lip 2 extending around its periphery. The tray is generally rectangular with rounded corners. The longer sides 3 and 4 are herein defined as the rear and front sides respectively. Inlets 5,6 for optical fibres are provided at each end of rear side 3. A first optical fibre retaining means 7,8 is provided adjacent to each inlet 5,6. Each retaining means 7,8 comprises a plurality of individual elements 9 between which individual optical fibres can be retained.

A second optical fibre retaining means 10,11 is provided adjacent each inlet. This consists of a bar of material extending over the path of the optical fibres which defines an opening 12,13 diagonal to the path of the fibres when retained by elements 11. Bend radius control means 14, 15 are located adjacent to the inlets to prevent optical fibres installed on the tray being bent into a curve of such a small radius that the optical fibre is damaged or its performance impaired.

A plurality of optical fibre connector retaining means 16 are disposed on the surface of the tray in a line extending across the tray from its rear to its front side. The retaining means are aligned so as to receive connectors aligned perpendicularly to the direction of entry of optical fibres through the inlets.

The bend radius control means 14, 15 define a path which extends away from and then back towards the rear wall 3.

The peripheral rim 2 is provided with inwardly extending projections 17 which help to retain optical fibres on the tray and which may also help to hold individual trays apart.

Figure 2 shows two optical fibres pigtails 18,19 in place on the tray. The pigtails are terminated with optical connectors 20,21 suitable for mating with corresponding connectors on optical fibres introduced into the tray from the other inlet.

The direct path from the inlet to the connector retaining means retaining connector 21 is much shorter than that to the retaining means retaining connector 20. However the bend radius control means 15 defines an elongated path which not only protects the fibres against damage but helps to equalise the lengths if the paths so enabling pigtails of uniform length to be used.

Connector retaining means are provided to retain eight connectors. Typically optical fibre cable comprises tubes each containing eight fibres. The arrangement shown in thus particularly convenient for use with such cables. The number of individual connectors per tray is sufficient but not excessive so as to complicate working with the cables. A plurality of individual trays can be used to obtain the required patch connections.

Figure 3 shows how individual trays can be hinged (by means not shown in detail) so that individual trays in a stack can be exposed for access.

Claims

1. A fibre optic patch panel tray having a rear side with two separate inlets for optical fibres, a front side, and at least one of the following:

   (a) optical fibre bend radius control means adjacent to each inlet, and a plurality of connector retaining means for retaining mateable fibre optic connectors extending across the tray between the rear and front sides;

   (b) a first optical fibre retaining means adjacent the inlet having individual retaining elements for removably retaining optical fibres;

   (c) a second optical fibre retaining means adjacent the inlet extending across the inlet but having an opening at an angle to the path of optical fibres when retained by the first retaining means through which individual optical fibres can be passed when removed from the first optical fibre retaining means.

2. A method of making removable connections between two groups of optical fibres by means of an optical fibre pigtail retained on a tray, the method comprising

   (i) removably locating a first set of optical fibre pigtails in an optical fibre retaining means mounted on the tray so as to leave a first set of free (preferably substantially equal) lengths of optical fibres each terminated by a mateable connector,

   (ii) removably locating a second set of optical fibres in another fibre retaining means mounted on the tray so as to leave a

second set of free (preferably substantially equal) lengths of said optical fibre each terminated by mateable connector, the mateable connectors of the said first and second set of optical fibres being mateable together,

(iii) mating together the mateable connectors so as to connect the optical fibres,

(iv) locating the mateable connectors in connector retaining means arranged to align the connectors in a direction substantially perpendicular to the direction of the retained portions of optical fibre entering the tray.

Fig.1.

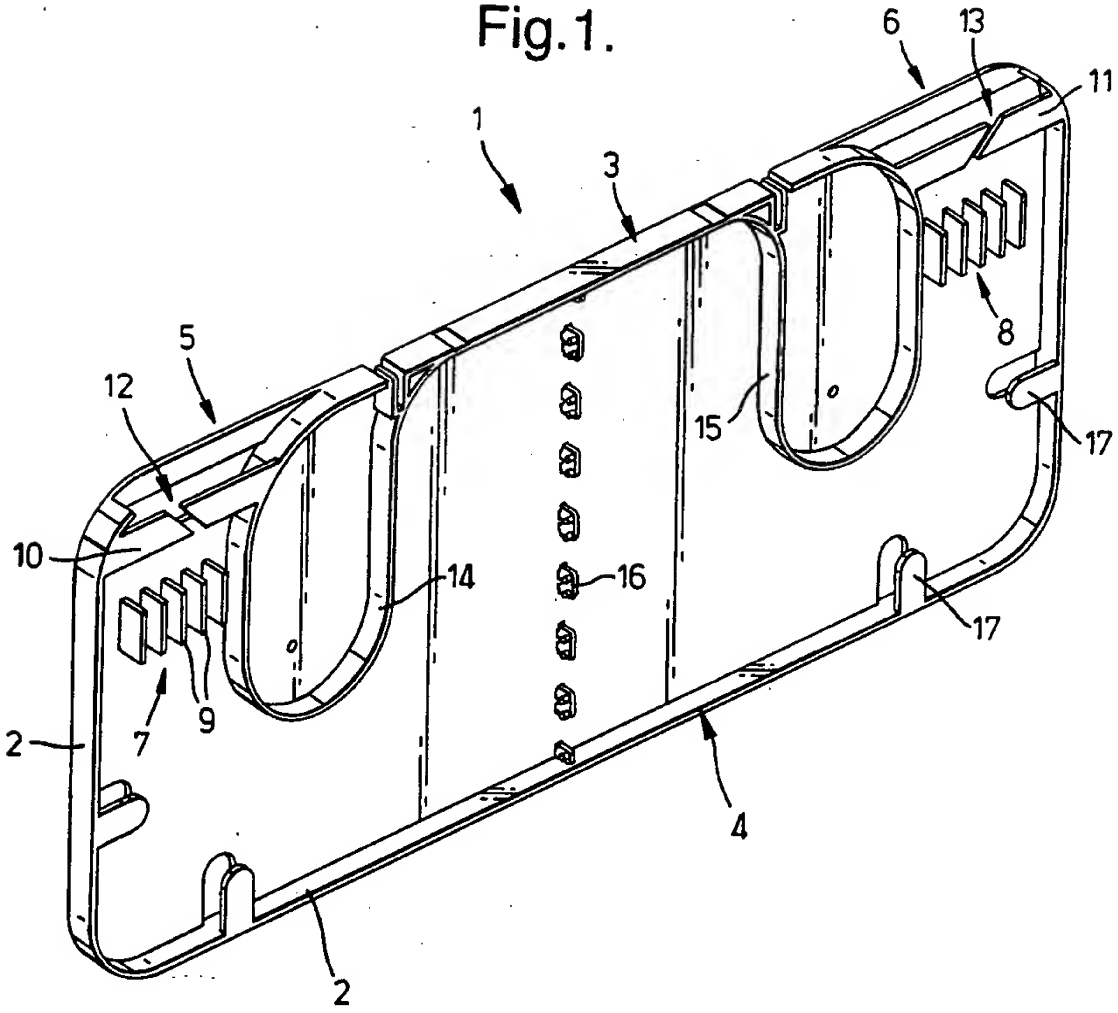


Fig.2.

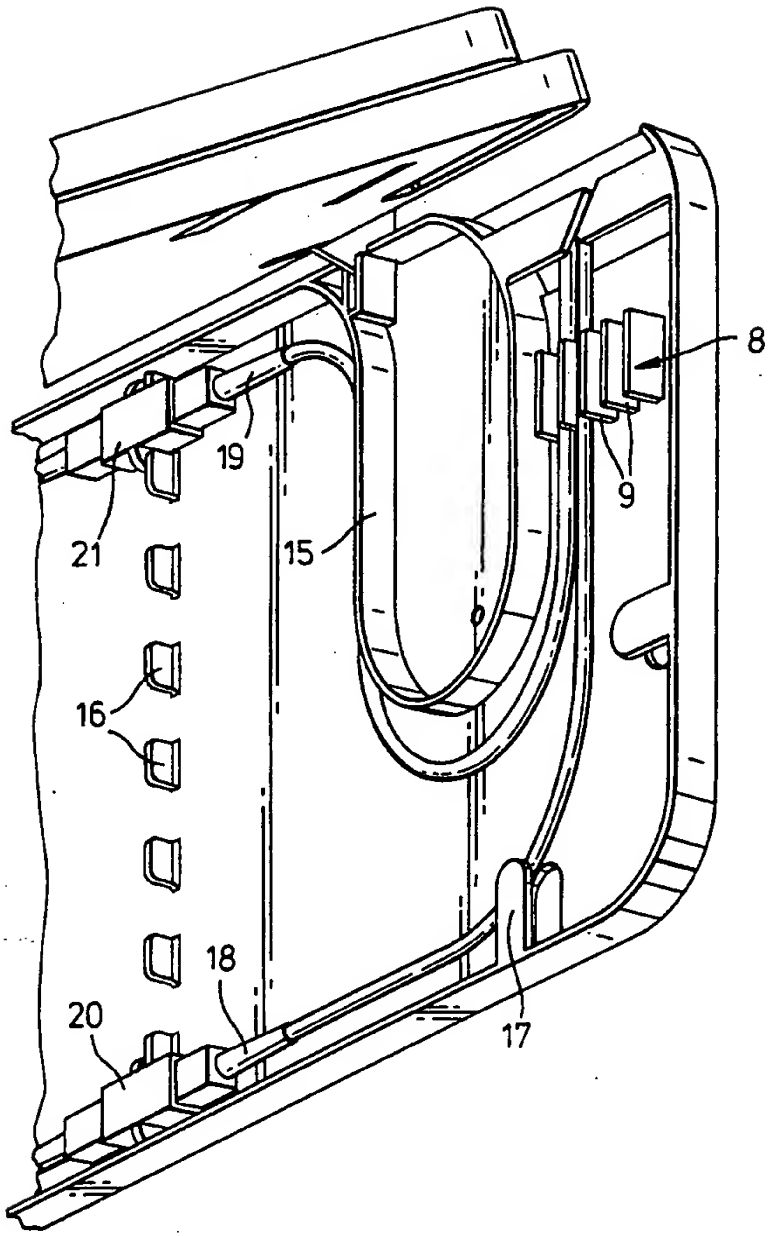
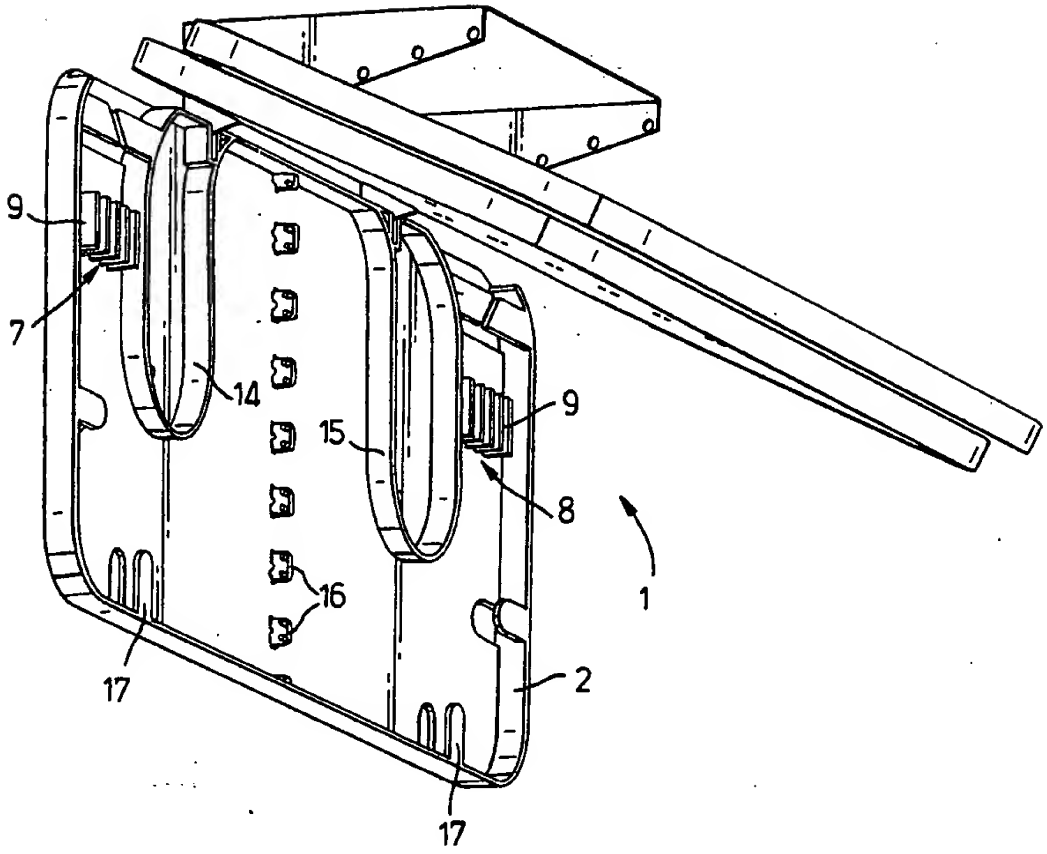


Fig.3.



INTERNATIONAL SEARCH REPORT

Internatio. application No PCT/GB 95/00918

A. CLASSIFICATION OF SUBJECT MATTER
G 02 B 6/46,G 02 B 6/48

According to International Patent Classification (IPC) or to both national classification and IPC 6

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G 02 B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 4 840 449 (GHANDEHARIZADEH) 20 June 1989 (20.06.89), fig. 1-7. --	1,2
A	DE, A, 3 530 162 (ROSE GMBH) 05 March 1987 (05.03.87), fig. 1-4. --	1,2
A	US, A, 5 100 221 (CARNEY et al.) 31 March 1992 (31.03.92), abstract; fig. 11-16,19,20. --	1,2
A	EP, A, 0 408 266 (BICC) 16 January 1991 (16.01.91), column 1, lines 14-34;	1,2

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